

Qualitative Estimation of Heavy Metals and Inorganic Elements in the Leaves of *Clerodendrum Viscosum* Vent.: A Pharmacognostic Quality-Control Study

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Abstract: *Clerodendrum viscosum* Vent. is a medicinal plant traditionally used in various systems of medicine and has attracted considerable interest because of its diverse phytochemical and pharmacological properties. Standardization of medicinal plant materials is essential to ensure identity, purity, quality, and safety prior to their use in pharmacological investigations and herbal drug development. The present study was undertaken to perform qualitative screening of selected heavy metals and inorganic elements in the leaves of *Clerodendrum viscosum* as an additional quality-control parameter. The shade-dried powdered leaves were subjected to controlled incineration to obtain total ash. The ash was treated with 50% v/v hydrochloric acid, filtered, and the resulting filtrate was subjected to classical qualitative chemical tests for selected metallic elements and inorganic anions. The analysis included aluminium, arsenic, calcium, copper, iron, lead, magnesium, mercury, potassium, carbonate, chloride, phosphate, and sulfate, along with other selected inorganic constituents. No characteristic positive reactions were observed for the tested elements under the experimental conditions. In particular, arsenic, lead, and mercury were not detected by the qualitative procedures employed. These findings provide preliminary evidence that the investigated *C. viscosum* leaf material did not show detectable qualitative contamination by the tested heavy metals and inorganic elements. However, qualitative testing cannot establish absolute absence or regulatory compliance; therefore, quantitative instrumental techniques are recommended for definitive heavy-metal determination.

Keywords: *Clerodendrum viscosum*, heavy metals, inorganic elements, qualitative analysis, medicinal plants, quality control, elemental screening.

I. INTRODUCTION

Medicinal plants constitute an important source of therapeutic agents and continue to play a significant role in traditional and modern healthcare systems. Plant-derived materials are widely investigated for their pharmacological potential, including antimicrobial, antioxidant, anti-inflammatory, hepatoprotective, and other biological activities. However, increasing utilization of herbal materials has emphasized the importance of establishing appropriate standards for their identity, purity, quality, and safety. Adulteration, substitution, environmental contamination, improper collection, and inadequate processing may influence the quality and therapeutic consistency of herbal drugs.



Clerodendrum viscosum Vent., belonging to the family Lamiaceae as reported in the source manuscript, is a medicinal shrub distributed in tropical and subtropical regions, including India and other parts of South and Southeast Asia. The plant has traditionally been used for several ailments, including skin disorders, wounds, inflammation, fever, bronchial disorders, and gastrointestinal disturbances. Its leaves are particularly important in traditional medicinal preparations.

Phytochemical investigations have reported the presence of several classes of secondary metabolites in *C. viscosum*, including flavonoids, phenolic compounds, terpenoids, steroids, alkaloids, and glycosides. The reported biological activities of the plant include antimicrobial, antioxidant, anti-inflammatory, analgesic, antipyretic, hepatoprotective, wound-healing, and cytotoxic activities.

In addition to phytoconstituents, medicinal plants contain inorganic constituents that may originate from both natural mineral nutrition and environmental exposure. Plants can absorb mineral elements from soil and water, while atmospheric deposition, agricultural practices, fertilizers, and contamination during collection or processing may contribute additional inorganic materials. Consequently, qualitative and quantitative assessment of inorganic constituents forms an important component of the overall quality evaluation of medicinal plant materials.

Certain elements such as calcium, magnesium, potassium, and iron have important physiological functions, whereas potentially toxic elements such as arsenic, lead, and mercury are undesirable contaminants. Their presence in medicinal plant materials may have toxicological implications, particularly when the material is consumed repeatedly or used as a source of extracts for biological studies.

Despite these investigations, elemental screening provides an additional dimension to the quality-control profile of the crude drug. Therefore, the present study was undertaken to qualitatively investigate selected heavy metals and inorganic elements in the powdered leaves of *Clerodendrum viscosum*. The objective was to determine whether characteristic qualitative reactions could be observed for selected potentially toxic metals and inorganic constituents and thereby provide additional preliminary information regarding the quality and safety of the investigated plant material.

II. MATERIALS AND METHODOLOGY

2.1 Plant Material

Fresh and healthy leaves of *Clerodendrum viscosum* were collected from Bela, Kasaragod District, Kerala, India. The collection was carried out during October. The collected leaves were washed thoroughly with running water followed by distilled water to remove adhering impurities. The plant material was shade-dried at room temperature until constant weight was obtained and subsequently powdered using a mechanical grinder. The powdered material was passed through a 40-mesh sieve and stored in an airtight, moisture-proof container until further analysis. These collection and processing procedures correspond with the methodology reported in the source study.

2.2 Preparation of Ash

An accurately weighed quantity of the powdered leaf material was transferred to a clean, preheated silica crucible. The material was subjected to controlled incineration at approximately 450–500°C until the organic matter was removed and a stable ash was obtained.

The ash was allowed to cool in a desiccator and subsequently treated with 50% v/v hydrochloric acid. The mixture was allowed to stand for approximately one hour to facilitate dissolution of acid-soluble inorganic constituents. The resulting preparation was filtered through Whatman filter paper, and the clear filtrate was used for the qualitative analysis of selected inorganic constituents.

Controlled incineration was employed to concentrate the inorganic fraction while minimizing interference from the organic plant matrix. Care was taken to avoid excessive heating because certain inorganic constituents may be lost through volatilization.

2.3 Qualitative Analysis of Metallic Elements

The acid-treated filtrate was subjected to classical qualitative chemical reactions for the detection of selected metallic elements.



Aluminium

Aluminium was tested by treatment with dilute ammonium hydroxide. Formation of a white gelatinous precipitate of aluminium hydroxide was considered indicative of aluminium.

Arsenic

Arsenic was qualitatively examined using a copper sulfate-based reaction. Formation of the characteristic copper arsenite precipitate was considered a positive indication.

Calcium

Calcium was tested using ammonium carbonate solution. Formation of a white precipitate corresponding to calcium carbonate was considered indicative of calcium.

Magnesium

Magnesium was qualitatively examined using ammonium hydroxide under appropriate reaction conditions.

Copper

Copper was tested using ammonia, with the development of a characteristic deep-blue complex considered indicative of copper.

Iron

Iron was examined using potassium ferrocyanide. Formation of a characteristic blue coloration or precipitate was considered a positive reaction.

Lead

Lead was tested using dilute hydrochloric acid. Formation of a white precipitate was considered indicative of lead.

Mercury

Mercury was examined using potassium iodide. Formation of the characteristic yellow precipitate was considered a positive reaction.

Potassium

Potassium was tested using perchloric acid, with formation of the characteristic crystalline precipitate considered indicative of potassium.

2.4 Qualitative Analysis of Inorganic Anions

Selected inorganic anions were also qualitatively examined.

- **Chloride:** tested using silver nitrate; formation of a curdy precipitate was considered positive.
- **Carbonate:** examined by reaction with dilute acid followed by the lime-water test.
- **Phosphate:** tested using ammonium molybdate; formation of a characteristic yellow precipitate was considered positive.
- **Nitrate:** examined using the brown-ring test.
- **Sulfate:** tested using barium chloride; formation of a white precipitate was considered positive.
- **Borate:** where applicable, the sample was treated with sulfuric acid and alcohol followed by ignition; a characteristic green flame was considered indicative of borate.

2.5 Interpretation of Results

The qualitative observations were recorded based on the presence or absence of the characteristic colour change, precipitate, or other diagnostic reaction associated with each element or ion. A negative result indicates that no characteristic positive reaction was observed under the experimental conditions employed. It does not establish absolute absence or provide a quantitative concentration.

III. RESULTS AND DISCUSSION

3.1 Qualitative Analysis of Heavy Metals and Inorganic Elements

The qualitative analysis of powdered *Clerodendrum viscosum* leaves showed negative observations for all the tested elements and inorganic ions. No characteristic positive reactions were observed for aluminium, arsenic, calcium, carbonate, chloride, copper, iron, lead, magnesium, mercury, phosphate, or sulfate.



Table 1. Qualitative analysis of heavy metals and inorganic elements in *Clerodendrum viscosum* leaves

Sl. No.	Element / inorganic ion	Observation
1	Aluminium (Al)	–
2	Arsenic (As)	–
3	Calcium (Ca)	–
4	Carbonate (CO_3^{2-})	–
5	Chloride (Cl^-)	–
6	Copper (Cu)	–
7	Iron (Fe)	–
8	Lead (Pb)	–
9	Magnesium (Mg)	–
10	Mercury (Hg)	–
11	Phosphate (PO_4^{3-})	–
12	Sulfate (SO_4^{2-})	–

Note: “–” indicates that no characteristic positive qualitative reaction was observed under the test conditions.

3.2 Discussion

The qualitative elemental analysis did not demonstrate characteristic positive reactions for the selected heavy metals and inorganic constituents of particular significance was the absence of detectable qualitative reactions for arsenic, lead, and mercury, which were included because of their toxicological importance in medicinal plant materials.

The present qualitative elemental results are therefore consistent with the overall quality profile established for the plant material. The low foreign organic matter value of 1.86% w/w and moisture content of 7.05% w/w reported in the source study further indicate appropriate collection, processing, and storage of the sample.

The absence of a positive qualitative reaction for arsenic, lead, and mercury provides preliminary evidence that these elements were not detectable using the employed qualitative procedures. This is relevant because medicinal plants may accumulate inorganic contaminants depending on environmental conditions and agricultural or processing practices.

IV. CONCLUSION

The present study provided a qualitative assessment of selected heavy metals and inorganic elements in the leaves of *Clerodendrum viscosum*. The powdered leaf material was subjected to controlled incineration, acid treatment, filtration, and classical qualitative chemical analysis.

No characteristic positive reactions were observed for the tested elements, including aluminium, arsenic, calcium, carbonate, chloride, copper, iron, lead, magnesium, mercury, phosphate, and sulfate. In particular, arsenic, lead, and mercury were not detected by the qualitative procedures employed.

Nevertheless, the present qualitative screening should not be considered a substitute for quantitative heavy-metal determination. Further studies using validated instrumental analytical techniques are recommended to determine the precise concentrations of individual elements and to establish compliance with applicable safety standards.

Overall, the present elemental screening contributes additional baseline information for the standardization of *C. viscosum* leaves and supports their further investigation for phytochemical, pharmacological, and herbal drug-development studies.

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